

SUPPURATIVE PERICARDITIS.*

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THE literature of purulent pericarditis has been admirably collated by Roberts and C. B. Porter. By the former surgeon 37 instances of operation for that condition were tabulated from different sources in 1897 and to that number 10 additional cases, reported in the literature between 1897 and April, 1900, were added by Porter. In the present instance, the rarity of this condition fully warrants the publication of a case of this kind recently under the writer's observation, while, at the same time, an opportunity is afforded for brief mention of those cases that have been published since Porter's contribution in 1900.

An analysis of cases of suppurative pericarditis hitherto published shows that in the great majority of instances this condition is secondary to some distant focus of infection, while only exceptionally is the infection either introduced directly into the pericardium or of unknown origin. Thus in 19 of Roberts' series of 39 cases there is a history of a focus of infection in either the lung or pleura or both, in 6 others the primary focus consisted of an acute osteomyelitis; in four others (as in the writer's case) the original infection could not be traced, while in only three instances the pyopericarditis was the direct result of a penetrating wound. In many of the secondary cases, the pyopericarditis was only one of a number of metastatic purulent foci such as are commonly associated in a condition of general sepsis. Closely associated with the etiology is prognosis and it is needless to say that the prospect of a cure after operation is much more favorable where the infection is limited to the pericardiac sac than where

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the pyopericarditis is a part of a general sepsis. That occasional recoveries are secured however in this latter group of cases certainly warrants surgical interference under all circumstances where the patient is not moribund as the only chance of averting a fatal issue.

The pathological changes in pyopericarditis are interesting and important. Usually the entire pericardium is converted into an abscess cavity, the heart, according to Brentano, being displaced downward and forward against the chest wall, a position, in which exploratory puncture may readily penetrate one of its chambers. Occasionally, as in the writer's case, the heart is more deeply seated and not likely to be damaged by the exploratory needle. Exceptionally, the pericardium may be subdivided into several distinct abscess cavities as in the cases of Delorme (mentioned by Roberts) and of Coutts and Rowlands. Such a condition is favored by adhesion of the heart to the anterior pericardium, the abscess cavities being situated laterally and posteriorly. The character of the purulent exudate varies. In the early stages, especially after infectious penetrating wounds and as a complication of pneumonia, it may be first serous and subsequently become purulent. It varies also in color and consistency as well as in the variety and number of germs which it contains. A thick consistency naturally increases the difficulty of diagnosis by exploratory puncture. Purulent foci are also occasionally observed in the heart muscle. Thus, in the autopsy of Sibley's case several small abscesses were found in the wall of the heart and in another similar case reported by Brentano, the direct cause of death was said to have been a rupture of such an abscess into the cavity of the left ventricle. In Sibley's case (Case XV) the pus had been detected by exploratory puncture and although the heart proved to be deeply seated in the pericardium, a puncture of its wall by the exploratory needle is not inconceivable.

The lesions of pyopericarditis of unknown origin or of those due to penetrating wounds—the so-called primary cases—are not always confined to the pericardium and heart. The

infection frequently spreads to the anterior mediastinum and contiguous pleura. In Coutts and Rowlands's case (Case VII) an autopsy, 16 weeks after the drainage of a pyopericarditis complicating pneumonia and empyema, in a child two and one half years old, showed that the entire anterior mediastinum was occupied by a thick fibro-gelatinous deposit. In the writer's case, the anterior mediastinum was evidently infiltrated with a large serous exudate, the anterior wall of the pericardium lying at least an inch beneath the sternum. Such a condition may readily prevent the approximation of the divided edges of the pericardium to the skin, as recommended by Bretano, Porter, and others, and necessitates the drainage of the abscess cavity from a considerable depth through the intervening mediastinum.

The changes in the pleura may either precede or follow those of the pericardium. In the former instance a localized empyema associated with an infectious pneumonia or merely the result of the lodgement of an infectious embolus may invade either pleural cavity at a point remote from the pericardium. In the latter instance, the opposed surfaces of the pleura may at first be glued together by fibrinous exudate for the purpose of self-protection against the extension of the pericardial abscess. Such a barrier may subsequently prove inefficient and a localized empyema close to the pericardium may appear, without, however, any demonstrable connection between the two abscess cavities. The importance of recognizing an associated empyema, whether primary or secondary, cannot be unduly emphasized, for in the event of such a complication it is only by proper incision and drainage of the purulent foci in both the pleura and pericardium that the recovery of the patient may be hoped for. The apposition of the opposed pleural surfaces by plastic exudate in the early stages of the extension of the pericarditic abscess may obliterate the corresponding part of the pleural cavity and may prevent a successful separation of the inner angle of the pleura from the anterior surface of the pericardium. Such artificial separation of the normal pleura is usually possible

and, in pyopericarditis, is always to be attempted by the surgeon in order that the underlying pericardium may be divided and the abscess material be evacuated without risk of pleural contamination.

Lesions in more remote parts of the body are those of the primary focus of infection or of the resulting metastatic abscesses and require no special description.

The clinical features of pyopericarditis form a distinct and typical picture only in the primary group of cases. Here the constitutional symptoms are those of a variable degree of sepsis while the local symptoms are those of a pericarditis with effusion. On the other hand, in secondary pyopericarditis the symptoms are frequently masked by those of the primary lesion and particularly in children the abscess in the pericardium may be entirely overlooked. In this group the diagnosis must be made chiefly on the character of the physical signs although the chance of error is well shown by the testimony of several observers who call attention to the similarity of the physical signs of fluid in the pericardium to those of a dilated heart. Although an exhaustive discussion of the differential diagnosis of these two conditions is beyond the scope of this paper yet, as an important preliminary to exploratory puncture as a means of diagnosis, the writer wishes to emphasize the value of a differential leucocyte count. Coutts and Rowlands mention a "high" leucocyte count in a child one and two-thirds years old and in the case reported by Scott the leucocytes, which during a previous pneumonia were normal, increased in number as soon as the complicating pericarditis developed. In the writer's case a number of examinations of the blood gave an average leucocyte count of over 20,000.

In the presence of a high leucocyte count exploratory puncture is justifiable. The risks of this procedure have probably been overestimated. That the needle may enter the heart and that this accident is favored by the intervention of the heart between the fluid and the chest wall cannot be denied; that laceration of the heart may also be caused by

contact with the pointed needle is also quite possible; and finally, equally true is it, that the needle may penetrate the left pleural cavity with or without the lung and so, in its withdrawal, form a new channel for the spread of the infection beyond the pericardium. In fact, such accidents are on record in medical literature. Thus Burtenshaw reports a case of paracentesis in which the trocar was first introduced into the right ventricle and 10 ounces of blood were withdrawn before the mistake was discovered. This accident, however, did not prevent the patient's recovery. A. Meldon collected in 1897 100 cases of paracentesis of the pericardium with only one fatality from laceration of the right ventricle. Case XII, reported by Peters, seems to have been an instance in which a subsequent empyema may have been the result of infection spreading along the course of the needle from the punctured pericardium. On account of the rarity of these accidents, however, one should not be deterred from making the necessary exploration, especially when every preparation has been made for immediate operation in case pus is discovered, for with such a precaution the resultant damage to the heart or the possibility of laying open new paths of infection along the course of the needle would be greatly minimized.

The possibility of such accidents, however, has led to a wide variability in the choice of a site for puncture. The risk, theoretically, of penetrating the left pleural cavity is shown by a study of the relation of its reflections to the chest wall. Investigations by Silk, Dwight and others have shown that the median reflection of the left pleura lies under cover of the sternum at the fifth costal cartilage and usually also beneath the sixth, while generally at the seventh there is an interval between it and the edge of the sternum. It is only therefore at or below this level that the pericardium can be entered in exploratory puncture without first passing through the overlapping pleura. This is probably the reason why Roberts and others favor a point of puncture close to the ensiform cartilage opposite the seventh costal cartilage. That a similar condition would obtain in the presence of a pyopericarditis, might be

inferred from the investigation of Delorme and Mignon, who have demonstrated the fact that distention of the pericardium with fluid has little or no effect in displacing the median pleural reflection outward. But artificial serous distention is not purulent distention and according to the observations of Glück, the left lung at least is displaced so far outward, if not the pleura as well, that, in puncture made just within the outermost limit of the precordial dulness, the needle readily penetrates the distended pericardium without damage to the lung or its investing pleura. This view has the support of Curschmann and others who unite in maintaining that exploratory puncture at the designated point is preferable, in that it incurs much less risk of tearing the heart, which is usually pressed forward, than a puncture close to the sternal edge.

In the writer's single experience, the left lung did not appear in the operative field and the pleura was not opened in the exposure of the pericardium at a point one and one-half inches from the sternal edge at the level of the fifth costal cartilage. Two preliminary exploratory punctures at a point slightly external had also proved harmless. That, on the other hand, the left pleural cavity has been opened in a number of operations for pyopericarditis, is a matter of record and the occurrence of such an accident seems to depend upon the degree of plastic exudate with consequent obliteration of the median pleural angle which has taken place, prior to the operation, and to which reference has already been made when speaking of the pathological changes of this condition. In general, it may be stated, that usually sufficient obliteration has already taken place prior to the operation to minimize the danger of damage to, or contamination of the left pleural cavity during the necessary exposure of the distended pericardium.

It is also important to emphasize that here, as in purulent collections of all kinds, exploratory puncture sometimes fails to withdraw pus. Thus Lyonnet reports a case in which two explorations proved unsuccessful where on subsequent autopsy

between 50 and 60 ounces of pus were found in the pericardium. In this case the heart, although adherent anteriorly, showed no trace of needle puncture. In every case of suspected pyopericarditis, where puncture is unsuccessful, the question of operative interference must be determined by the character of the physical signs, the degree of dyspnoea, the other symptoms of impeded and insufficient heart action and the degree of leucocytosis.

In the consideration of the clinical features of pyopericarditis, mention has been made of a group of cases occurring especially in children in which the lesion is overlooked. In this connection, it is well to call attention to the possibility of the local symptoms of this condition simulating those of a peritonitis. As in pneumonia, so in a pericarditis, and again especially in children, such an atypical clinical picture is apt to occur and even lead to the needless exploration of the abdominal cavity before the actual condition is recognized.

TREATMENT.

Except where the patient is already in *extremis* or moribund, operative treatment is indicated and should take place without delay in all cases of suppurative pericarditis as soon as the diagnosis is confirmed by the needle. Moreover in those cases in which exploratory puncture fails to withdraw pus, operation is justified by evidence of continued insufficient cardiac or respiratory action. Operative relief should also be extended to patients with advanced serous pericarditis in which aspiration either fails or is followed by rapid reaccumulation of the fluid with a return of cyanosis, dyspnoea, syncope or other serious symptoms.

Puncture, alone, in pyopericarditis, with the exception of a few scattered instances in which a cure has resulted from the gradual enlargement of the puncture channel into a permanent fistula, affords at the best but temporary relief. As a rule the removal of pus in this way is but partial and its reaccumulation is rapid. Repeated punctures, in the hope

of effecting a permanent cure, prolong the length of septic absorption and diminish the chance of success by subsequent operation. Its use, therefore, should be strictly restricted to diagnostic purposes.

Operation proper consists merely in the opening of the pericardium and in the provision for satisfactory drainage. For this purpose different routes have been either suggested or practised by their authors with the common object of minimizing the risk of opening the left pleural cavity. Thus Bacon advocates trephining the lower end of the sternum, but although, according to Curschmann, Riolan, Skelderop and Velpeau advocated a similar measure, no cases operated on by this route have as yet been reported. The writer suggests that the necessarily restricted space might unduly hamper the exposure of the pericardium especially in the presence of an anterior mediastinitis, and would greatly increase the difficulty of suturing the divided edges of the pericardium to the skin. Furthermore the constant passage of purulent material over freshly denuded bone might result in protracted if not a serious osteitis.

In cases, hitherto published, including those of the Roberts and Porter series, the pericardium has been opened after the resection of an overlying costal cartilage. Roberts suggests that a musculocartilaginous flap consisting of the median portions of the 4th, 5th, and 6th costal cartilages and of the tissues of the intervening spaces, be raised from the anterior surfaces of the pericardium and pleura. This affords sufficient space for possible ligation of the internal mammary vessels as well as for the outward reflection by the surgeon of the left pleural angle, thus avoiding the risk of opening that cavity in the subsequent division of the pericardium. After the evacuation of the pus, the flap is replaced, leaving a sufficient orifice for drainage. Roberts had no case to report and no instance of his operation has thus far been published. Although it gives admirable exposure and amply fulfils the objects for which it was devised, yet the very serious condition of many of these patients, especially in

secondary cases, seems to demand an operation that combines the elements of speed and simplicity, such as may be obtained by the rapid removal of a single costal cartilage, rather than one which would necessarily severely tax both the resistance and the reparative power of the patient. Allingham has suggested a different route, the "epigastric," and has had several opportunities of testing its efficiency. In this operation, an incision, made to the left of the median line just below the costal insertion of the rectus muscle, is gradually deepened upward through the costoxiphoid space in the diaphragm to the base of the pericardium, the peritoneum being pushed downward. It is thus seen to be a modification of Larrey's suggestion. In a discussion with Coutts and Rowland, Allingham refers to three successful cases operated on by this method the details of which, he declared, were to be published shortly. The operation certainly combines the advantages of opening the abscess in a dependent point and of probably avoiding the left pleural cavity. Its chief disadvantage is its length, the duration of the average operation being at least 20 minutes. The dangers of opening the peritoneal cavity and of hemorrhage from the terminal branches of the internal mammary artery are largely theoretical.

The simplest and most rapid exposure of the pericardium is accomplished by the removal of the inner part of either the 5th or 6th costal cartilage through an oblique incision parallel to its long axis. This opening is deepened into the anterior mediastinum by the division of the perichondrium and the underlying plane of the triangularis sterni. The condition of the contiguous pleural reflection is then, if possible, determined. In the absence of adhesions the pleural angle is pushed outward without, if possible, any extension of the external incision. If obliteration of the pleural cavity has taken place, the underlying pericardium may readily be opened without danger of pleural penetration. The presenting pericardium is best divided by scissors between two pairs of forceps and the opening sufficiently enlarged to permit the passage of a finger. The pus is allowed to escape slowly in order that the

heart action may not be unfavorably influenced. As the flow of pus ceases, the finger may be cautiously introduced through the opening and passed backward to either side of the heart with the object of separating adhesions as well as of detecting any hidden accumulation of pus that may have become shut off from the main cavity.

Usually subsequent irrigation with either a saline or weak antiseptic solution is desirable, if adequate provision is made for the free exit of the fluid from the interior of the pericardium. Failure to observe this precaution probably determined a fatal issue in Parker's case (cited by Roberts). The irrigation may be omitted if the patient's condition demands a speedy termination of the operation. No irrigation was used in the writer's case.

The divided edges of the pericardium should now be sewn to the skin wherever that is possible. This not only facilitates drainage but diminishes the risk of contamination of the anterior mediastinum. Such approximation may be prevented by a deep seated pericardium or, as in the writer's case, by a pre-existing mediastinitis.

Drainage is undoubtedly favored by the movement of the heart which, in the absence of adhesions, tends to force out any accumulated pus, even though the opening is not at the lowest point of the pericardiac sac. It is still further assisted by the insertion of either a rubber drain or a capillary drain of gauze into the abscess cavity, care being taken that they are so introduced as not to interfere with the action of the heart. Riedel (*Zentral. für Chir.*, 1897, p. 56) states that, in one of his cases, the use of a rubber drain caused stormy and irregular heart action and had to be discontinued. In the writer's case a rubber drain and, after several weeks, a drain of gauze, were used without any indication of cardiac interference. As the discharge decreases the drain should be shortened and its use discontinued at the earliest possible moment. The persistence of a sinus rarely occurs.

After healing is complete, insufficient or irregular heart action is the marked exception, neither is there any indication

of cardiac displacement. The patient, whose case is here reported, was in excellent condition after more than two years had elapsed since the operation, the precordial scar being the sole evidence of the former trouble. In the interval she has passed through one uneventful pregnancy.

That such a satisfactory result cannot always be expected, however, is shown in the report of a case by J. A. Scott in which, 4 months after an operation by LeConte for a pyopericarditis complicating pneumonia in an adult of 36, palpitation sufficient to interfere with the patient's work was present, although there was no physical sign that would indicate an adhesive pericarditis.

In conclusion the belief cannot be too strongly emphasized that every case of pyopericarditis in which the patient is not moribund, should be treated by an operation which, in those cases in which a general anæsthetic cannot be tolerated, may yet be successfully carried out under cocaine or some other suitable local anæsthetic.

Brief abstracts of cases published since 1900 follow:

CASES GATHERED FROM LITERATURE.

CASE I.—REICHARD (*Zentral. für Chir.*, 1900, p. 1109). Sex and age of patient not given. Pericarditis the result of penetrating stab wound with a knife.

Operation by Lindner, because of the almost moribund condition of the patient, the almost imperceptible pulse and great dyspnoea, was done largely without an anæsthetic (anæsthetic not mentioned). The pericardium was exposed by resection of the third costal cartilage and the ligation of the internal mammary artery, the abscess cavity being incised without damage to the pleura. There was a large amount of foul pus. Two thick drains with tamponade of wound. The operation which lasted ten minutes was followed by a gradual improvement of both pulse and respiration. Complete recovery at the end of 6 weeks.

CASE II.—(*Ibid.*). Etiology; influenza and rheumatism. The diagnosis was confirmed by puncture in the 5th left intercostal space outside the nipple line, a quantity of serohemorrhagic exudate being withdrawn with abundant pus cells. The condition of the patient was such as to forbid the extended use of a general anæsthetic.

Operation consisted in the resection of the fourth costal cartilage, the pleura being pushed to one side. On opening the pericardium a large amount of clear fluid forcibly projected. On account of the stormy action

of the heart no drain could be inserted into the abscess cavity. A drain, however, was placed down to the pericardium after the suture of its edges to the muscle wall. The recovery was gradual and was marked by a somewhat irritable heart action.

During the ensuing discussion Lindner stated that the selection of a different costal cartilage in these two cases was due to the difference in the extent and degree of the precordial dulness.

CASE III.—W. MINTZ (*Zentral, für Chir.*, 1904, 31, 59-61). History, cause, etc., not given.

Operation under cocaine anæsthesia; the 5th costal cartilage was exposed and resected through an incision over its long axis. On account of the fact that the opening did not correspond to the most dependent part of the pericardium a second incision was made along the lower border of the 7th costal cartilage and the pericardium exposed by blunt dissection. During convalescence almost the entire discharge passed through the lower opening. The statement is also made that this route was followed on one occasion by Larrey and that there is no danger of wounding the peritoneum if the exposed diaphragm is pushed downward and the pericardium entered at the inner angle of the incision.

CASES IV, V, AND VI.—Mentioned briefly by ALLINGHAM as three successful cases of which the details were to be published shortly, in the discussion with Coutts-Rowlands.

CASE VII.—COUTTS and ROWLANDS (*Brit. Med. Journal*, 1904, 1, 9-13). Child, two and one-half years old. One month prior to admission to the hospital the patient had had a pneumonia with an incomplete recovery and with some loss of flesh.

Physical examination revealed a condition of rickets. There was an increase in the area of cardiac dulness and an almost imperceptible apex beat. The heart sounds were weak but pure. There was no friction sound. The pulse was 136, regular and of fair tension. On the right side posteriorly there was dulness from the 6th rib downward, passing around the axilla toward the front of the chest. Over this area there was faint bronchial breathing. The left lung was normal. The respiration was 58, and the temperature varied between from 99 to 104 in the afternoon. Exploratory puncture yielded nothing but a little blood. During the next 5 days the precordial dulness gradually extended upward. The apex beat disappeared and the pulse, still regular, became more rapid and feeble.

Operation by Rowlands under chloroform. The pericardium was exposed by resection of the 5th left costal cartilage, the adjacent pleura being displaced outward. A half pint of pus rising to the height of three feet issued from the interior of the pericardium. Insertion of the finger into the abscess cavity. Large rubber drain. No irrigation. The immediate effect of the operation on both heart and respiration was beneficial.

On the following day, exploration of the right pleura yielded pus and, under chloroform, resection of a rib in the posterior axillary line with incision of the underlying pleura. For 3 days thereafter the condition of the patient was variable although on the whole improved. On

the 4th day after the original operation, the patient developed measles with subsequent pneumonia, death taking place at the 6th week from inanition, there having been a free discharge from the pericardium to the end.

Autopsy.—This showed the entire anterior mediastinum occupied by a thick gelatinous deposit. In attempting to separate the pericardium from the left pleura an abscess cavity was opened, being a part of the pericardium behind and to the left of the heart.

In the discussion Rowlands stated that it was impossible to open the pericardium behind without damage to the adjacent pleura, the larger azygos vein and the thoracic duct.

CASE VIII.—COUTTS and ROWLANDS (*Brit. Med. Journal*, 1904, January 22). Male. One and two-thirds years. Family history of phthisis. Measles 8 weeks before admission. Ever since a cough, increasing in intensity, has persisted. There has been much sweating. Patient complains of pain in the abdomen and loss of appetite.

Physical Examination.—The general condition is rachitic, and wasted. There are signs of consolidation over the right chest posteriorly, extending around into the axilla as far as the mammary line. The apex beat of the heart lies in the fourth space just within the nipple. The sounds are clear and distinct. Left lung is normal. At no time is the temperature higher than 100 and exploration of the chest fails to detect pus.

On the 9th day after admission, a patch of dulness appeared over the left base posteriorly and a needle inserted withdrew clear serum. The temperature became irregular.

On the 21st day precordial dulness was first noticed. At the end of a week it had extended upward to the 1st rib and over to the right of the sternum. Heart sounds were inaudible below the third space and very feeble above that line. The pulse was very rapid and almost imperceptible. Leucocytosis 32,000.

Operation.—Chloroform. Although puncture at the point indicated by Roberts as well as in the 5th left intercostal space failed to withdraw pus, the pericardium was exposed through the resection of the 7th costal cartilage and the adjacent part of the gladiolus. On opening the pericardium, between one and two ounces of pus escaped. The finger was passed to the base of the heart and into the oblique sinus below the heart. Drainage with two soft rubber tubes.

Patient gradually sank and died on the second day.

Autopsy.—The lesions pointed to a long existence of a pericarditis. Culture from the pus yielded pneumococcus. A thick layer of gelatinous pus covered the opposed parietal and visceral layers of the pericardium.

CASE IX.—KILIANI (*ANNALS OF SURGERY*, 1907, 45, p. 130). Man 22. Admitted to the German Hospital in 1901 for an attack of acute articular rheumatism, complicated by endocarditis and pericarditis. The pericardial effusion rapidly increased and became so threatening as to require immediate incision. Drainage of the pericardium was continued for seven days, after which time all oozing ceased. Immediately after

incision, the patient, who had been moribund, showed signs of improvement and his further recovery was uneventful. Five years after the operation the patient was in excellent health.

CASE X.—GENGENBACH (*Colo. Med.*, Denver, 1906, 3, 187-190). Male, 8. Mumps 3 years ago. Measles twice 2 years ago with an interval of 6 months between attacks. Scarlet fever complicated by mastoid suppuration 10 months ago. For the past 6 weeks has suffered from whooping cough and while the cough still persisted the present illness began 3 weeks before admission to the hospital with headache, vomiting, abdominal pain, and some fever. Pulse of 120 and respiration of 40. Although there was no local tenderness or rigidity a diagnosis of appendicitis was made. The chest showed the physical signs of either a bronchopneumonia or of a pericardial effusion.

Two days after admission patient became deeply cyanosed with symptoms of syncope. At that time the apex beat was not visible but was faintly palpable about one inch within and at the level of the nipple. The heart sounds were audible but indistinct. Cardiac dulness extended from the 2nd to the 6th rib and from one inch to the right of the sternum to the left mammary line. Paracentesis.

Two days after paracentesis, operation under chloroform by Dr. Craig. The 5th rib, one and one-half inches to the left of the sternum, was resected, the pericardium opened and one and one-half pints of pus evacuated. Rubber drain. Free discharge. "Double" coccus found in pus. The patient, collapsed by operation, rallied. Although the discharge gradually lessened and the tube could be withdrawn 3 days before the patient died, a fatal issue could not be averted.

Autopsy.—There was a large abscess occupying the entire left pleural cavity. There was no communication between this cavity and that of the pericardium.

CASE XI.—J. A. SCOTT (*N. Y. Med. Journal*, 1904, 1, 198-200). Male laborer, 36. Patient gave a history of pneumonia of the right base of 6 days' standing which, on the 3rd day, spread to the left base with pleurisy.

On the 13th day the apex beat was neither visible or palpable. There was no pericardial friction. On the 18th day the patient developed a pulsus paradoxus and exploration in the 4th right space withdrew serum which contained the pneumococcus. On the following day, exploration in the same place withdrew 14 ounces of sero-turbid fluid. Seven days after the needle withdrew thick yellow pus. With the advent of the pericarditis the leucocytosis, which during the pneumonia had been normal, materially increased.

Operation under chloroform by LeConte. On account of cardiac weakness the chloroform was superseded by cocaine. Through an incision in the 5th space the pericardium was opened and between a pint and a quart of pus evacuated. Rubber drain, which was removed on the 26th day after operation. Four months after operation palpitation still persisted and prevented the patient's working.

CASE XII.—G. A. PETERS (*Edinb. Med. Jour.*, 1903, n. s. 13, 200-216).

Boy, 7. Patient had both measles and scarlet fever some years ago. One month ago preceded by malaise of 3 days' duration, patient developed severe pain and tenderness about the umbilicus. The pulse increased to 100, the temperature to 100-102 and the respiration was short, frequent and grunting. The abdomen gradually became prominent and purgatives and enemata failed to act properly. In the second week of his illness the tenderness became limited to the upper part of the abdomen and dulness was elicited above the level of the umbilicus. Soon after dulness appeared over the left side of the chest with diminished respiratory murmur. Dyspnoea appeared and increased in severity. It was urgent at the time of admission.

Physical Examination.—The respiration was thoracic. There was dulness over the left side, especially anteriorly. The cardiac impulse could not be detected. Anteriorly the dulness extended up to the clavicle; posteriorly to the spine of the scapula, extending beyond the sternum to the right nipple and merging with the liver dulness below (a marked example of Rotch's sign of fluid in the pericardium). On auscultation the heart sounds were fairly audible about the left nipple with a slight systolic murmur. There was tubular breathing over the left chest. The fluid which was withdrawn from the pericardium by three widely separated punctures was opaque and rich in cellular elements.

Operation.—An incomplete operation was done through the 4th space three-quarters of an inch to the left of the sternum and 10 ounces of fluid withdrawn. The rubber drain was soon blocked with lymph and became ineffective. The urgency of the symptoms was much relieved. During the 2 days following, however, the patient became steadily worse with cyanosis and subnormal temperature, at the end of which time a complete operation was done under local anaesthesia as follows:

An incision was first made in the fifth space one-half inch to the right of the sternum and abandoned on account of the exposure of the pleura. An incision was then made in the 5th space on the left side and the pleura opened and packed without reaching the abscess cavity. The pericardium was then successfully exposed through an incision in the left 4th space three-quarters of an inch from the sternum and 29 ounces of pus containing the staphylococcus aureus was evacuated. Drainage with a long rubber tube. The discharge of the pus was followed by a return of the liver to its normal position.

Two weeks after this operation the dyspnoea increased and the general condition became weaker. Exploratory puncture at the angle of the left scapula withdrew pus and under ether 30 ounces of that fluid was evacuated from the left pleural cavity without the resection of a rib.

The patient eventually recovered and 11 months after the operation could play around as well as ever.

CASE XIII.—ARTHUR LATHAM and H. S. PENDLEBURY (*Lancet*, 1903, 1, p. 798). Male, 53. Six months before admission became short of breath which 5 months later compelled him to give up work. At this time the left pleural cavity was tapped and 10 ounces of serum withdrawn. The tapping was repeated on four different occasions afterward. Two

months ago œdema of the legs with some distention of the abdomen appeared. There was jaundice.

On admission the patient complained of sleeplessness and of cold extremities. The patient also complained of a cough with expectoration and of considerable shortness of breath with cyanosis. The pulse was 74, respiration 24, and the temperature was normal.

Physical Examination.—The cardiac apex could neither be seen, felt nor heard. The precordial dulness was much increased. There was dulness, diminished voice sounds and tubular breathing over the left axillary base. Over the left base posteriorly, the percussion note was impaired, the breathing distant and tubular and there were a few moist sounds. There was œdema of both lower extremities and the physical signs of ascites. Tapping 2 days after admission in the 4th space one and one-quarter inches to the left of the sternum withdrew 95 ounces of serous fluid of a brown color from the methæmoglobin which it contained. This was followed by a decrease in the œdema and in the abdominal distention. The cardiac sounds although faint were nevertheless distinctly audible. Owing to a recurrence of the fluid and its associated symptoms, operation under chloroform by Pendlebury, one week after the aspiration.

An Allingham operation was done and additional exposure gained by resection of the sternal end of the 6th costal cartilage. The finger inserted into the pericardium. There were no adhesions and the surface of the heart was smooth. One edge of the pericardium was stitched to the lower corner of the wound, a tube having been inserted into its cavity. The tube was removed on the fourth day and healing was complete at the end of the fourth week. At that time the patient was entirely free from dyspnœa, ascites and œdema. He also slept well at night. Four months after the operation patient returned to work.

CASE XIV.—A. HALL (*Lancet*, 1908, 2, p. 951). Female, 38. One month prior to admission patient was confined. One week later advent of puerperal sepsis with double pneumonia. The abdominal symptoms disappeared but the fever and weakness continued and on admission patient complained of extreme dyspnœa and had the appearance of being very sick.

Physical Examination.—The left side of the chest was almost motionless. No cardiac impulse palpable. Area of cardiac dulness extended from the upper border of the 2nd left rib above, one-half inch to the right of the sternum. On the right side laterally it extended down as far as the 5th rib and on the left side it corresponded to the mid-axillary line. The heart sounds were almost inaudible over the entire area. There was a slight pleuritic friction sound in the 5th left space near the nipple. There was dulness at the right base, and moist sounds over both bases posteriorly. The abdomen was full and distended but without sign of fluid. Urine scanty but normal. The pulse was 132, respiration 60, and the temperature between 100 and 101. There was a slight but frequent cough. A needle passed into the 5th space, passed through the diaphragm both near the edge of the sternum and at the level of the nipple. In the 4th space it passed into the pericardium and withdrew pure pus.

Operation by Wilkinson. Chloroform. Excision of the 4th left costal cartilage; 20 ounces of gray-yellow pus were evacuated without damage to the pleura. The pericardium was sutured to the skin and a large soft, collapsible tube inserted. A profuse discharge continued to the death of the patient one week after the operation.

Autopsy.—There was a small purulent pleuritic effusion over the right base. The death of the patient seemed to have been the result of a general suppurative peritonitis with dilatation of the stomach, which accounted for the unusually high position of the diaphragm. Examination of the pus in the peritoneal cavity showed both staphylococcus and streptococcus.

CASE XV.—W. K. SIBLEY (*Brit. Med. Journal*, 1903, 1, 1192). Male, 16. Prior history negative. Sudden onset of tonsillitis followed in 3 days by pneumonia. This ran a severe course, the pulse rising to 150, the respiration to 50-60, the temperature to 103 on the 6th day. At that time there were pleuritic râles outside the left nipple and impaired percussion over the left base. One week after the invasion of the tonsillitis there was pain with fulness and tenderness in the epigastric region. The heart sounds were indistinct, but there was no bruit. On the 9th day resolution by crisis occurred with rapid disappearance of all pulmonary symptoms. On the other hand, the area of cardiac dullness increased and the apex beat could not be felt and the heart sounds became very faint. In this condition the patient remained until the 21st day of the illness. On that day he became cyanosed with much dyspnea, especially while supine. The cardiac dullness increased both in an upward and outward direction. There was pulsus paradoxus, and on the following day the patient became pulseless. The heart sounds were scarcely audible. Pus was withdrawn by exploratory puncture in the area of precordial dullness and was found to contain the pneumococcus.

A. C. E. Mixture, afterward replaced by ether.

Operation by Lane. Under a general anæsthetic a local empyemic abscess was exposed after the resection of a portion of the 6th rib outside the nipple line. The pericardium could not be felt. Although somewhat relieved, symptoms indicating pent-up pus continued, and 10 days later a search of the empyemic cavity disclosed the pericardium bulging into it in such a way that it could easily be reached and opened with the finger, 10 ounces of pus, similar to that originally found in the pleural cavity, being evacuated. The heart was felt in the back part of the pericardium. A rubber drain at first inserted had to be discontinued on account of irritating the heart action. After a temporary improvement the patient continued to lose ground and died 10 days after the last operation. The necessary withdrawal of the drainage tube seemed to interfere with the proper drainage of the abscess cavity.

Autopsy.—There were a number of small abscesses in the wall of the heart from which some bleeding had occurred into both the pleural and pericardiac cavities. Pneumococci were found in great numbers in the blood. The writer states that probably a small amount of pus was present in the pericardium at the time of the first operation.

CASE XVI.—GLUCK (*Verhandlung, d. deut. Gesell. f. Chir.*, 1907, 36, 378-385). Male, 9. Extensive physical signs of fluid. Green-yellow pus withdrawn by needle in the 4th left space 1 cm. external to the mammary line. Subperiosteal resection of the 5th rib from a point opposite the mammary line 4 cm. externally. The pericardium was opened without damage to the pleura. At first the progress was satisfactory, but ultimately the patient died from general streptococcus infection. (See following case for a more detailed account of the operation and additional symptoms.)

CASE XVII.—GLUCK (*Ibid.*). Male, 56. "Patient operated on in the above manner and three months after was completely well."

In Cases XVI and XVII the patient had a pericardial reflex cough, difficulty in swallowing and a congested enlarged liver (marked by peculiar intense pain and swelling in the left lobe of the liver). In Case XVI this condition led to a primary laparotomy. In spite of an extensive exudate a pericardial friction sound was present in both cases.

The pericardium was exposed by a skin muscle flap with its base in the mammary line opposite the 4th, 5th and 6th ribs, and the 5th rib for a distance of 3 cm. external to the mammary line resected without damage to the pleura. In opening the pericardium the left border of the heart protruded, filling the opening so completely that only by the insertion of the finger between the heart and the inner surface of the pericardium could the fluid be evacuated. Drainage was continued for 6 weeks.

Before the operation the pulse was very irregular and over 150. Digitalis and morphine given both before and after operation. Drainage somewhat interfered with by the forward protrusion of the heart.

CASE XVIII.—STEWART and A. E. GARROD (*Proc. Roy. Soc. Med.*, London, 1907, 1, 15-17). Female, 5. Two days prior to admission to hospital a tonsillectomy was followed on the same evening by pain in the abdomen and left chest. On admission the temperature was 103 and the pulse 120.

Physical examination showed the presence of fluid in the left chest below the angle of the scapula. One week later pus was withdrawn and a localized empyema opened and drained by the resection of a rib. The pus contained pneumococcus. The operation was followed by improvement, but the temperature remained between normal and 102.

Three weeks after operation.—"During the past few days the temperature has increased to 104, the pulse to 140-150; the leucocytosis from 31,000 to 41,000 in an interval of two days. There have been two attacks of vomiting. Exploration of the old abscess cavity showed a bulging mass in the position of the pericardium." The child continued to grow worse and three days later the cardiac dulness was found to extend two inches to the right of the sternum and a skiagram showed a distinct shadow of a distended pericardium.

Operation.—"Under light anaesthesia the pericardium was opened through the empyemic cavity and several ounces of thick yellow pus evacuated. Drainage with a rubber tube."

After the operation the child's temperature gradually fell and reached normal in 3 weeks. Very little pus was discharged after the first day. Five weeks after the operation the wound had completely closed. Four months afterward the child had recovered its normal weight and appeared to be in robust health. The pulse was 100 and regular. The lung had fully expanded.

CASE XIX.—GODLEE (discussion of above). "The pyopericarditis was a complication of an acute infectious osteomyelitis and was operated on by Raymond Johnson through an anterior incision. Although the case was further complicated by abscess of the elbow and later of the brain, the boy ultimately recovered. One year later the patient died of a recurrence of the brain abscess."

Although because of the absence of details, no tabulation of the cases to which he refers can be made, it is interesting to note the statement of Samuel West in the same discussion, viz.: "Dr. Samuel West had seen several similar cases in which the pericardium was opened from the back and the drainage secured was satisfactory. The majority of the patients had died because the pericarditis was of pyemic origin. In his experience the prognosis of pericarditis the result of pneumococcus infection was more favorable than in those due to streptococcus. One case was opened anteriorly with perfect drainage and the patient was practically well in a week. Another case similar to the one under discussion terminated in the death of the patient. The speaker thought that ordinarily simple incision anteriorly without the resection of a rib would provide satisfactory drainage."

CASE XX.—H. S. PENDLEBURY (*Lancet*, 1904, 2, 1145). Male, 31. Pneumonia in the left lung. Three weeks after invasion of pneumonia, the temperature remaining high, considerable cyanosis and dyspnoea developed and examination showed that the cardiac dulness extended four inches to the right of the sternum. The heart sounds were muffled. The pericardium was exposed by resection of the 6th and 7th costal cartilages and between 3 and 4 ounces of serum evacuated. Adhesions between the heart and pericardium were broken down with the finger and a tube inserted. Rapid recovery, the tube being removed on the 6th day.

CASE XXI.—(*Ibid.*). Male, 12. On admission the patient was cyanotic and dyspnoeic and presented the physical signs of serous pericarditis and of endocarditis complicating an attack of acute articular rheumatism. Operation on the 6th day. The pericardium was exposed by resection of the 7th costal cartilage only. In pushing aside the left pleura, the right pleura was accidentally opened but without appreciable harm to the patient. On opening the pericardium the fluid which was under considerable pressure rapidly escaped. Death occurred five days later with little apparent benefit from the operation.

Autopsy.—The right pleura projected beyond the left side of the sternum down to the level of the 7th costal cartilage. The opening in the pericardium was not recognized, both its visceral and parietal layers being in contact and adherent. There was much endocarditis with valvular varicosities.

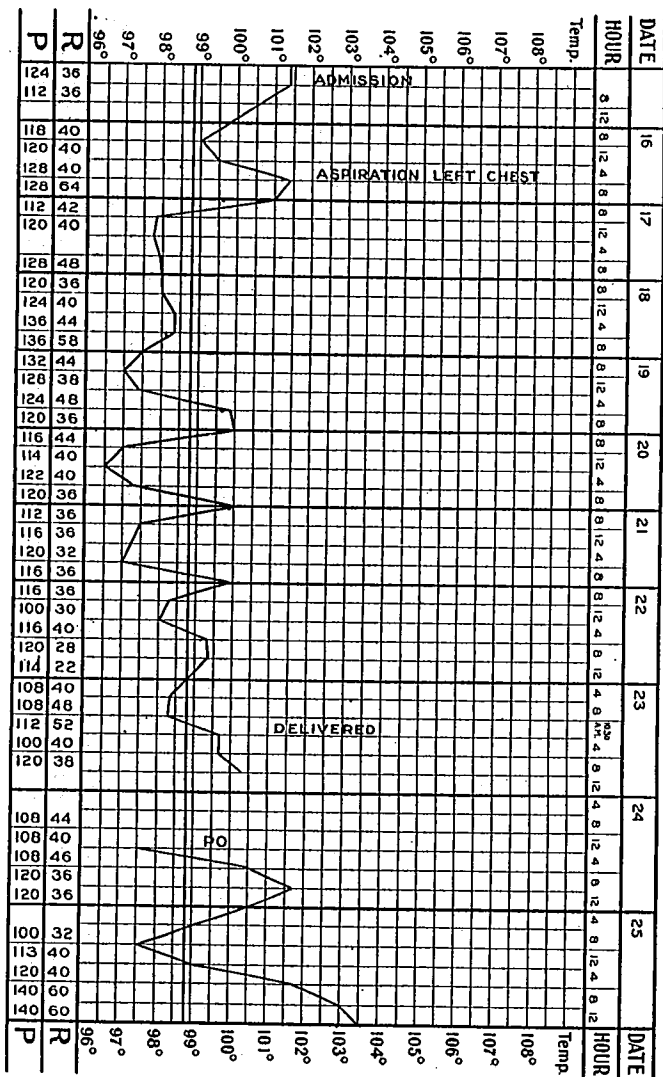
AUTHOR'S CASE.

Presbyterian Hospital, April, 1906. N. N., female, age 19. Admitted to the service of Dr. J. S. Thacher and Dr. Bovaird. Patient has always been well. She was married eleven months ago and has been pregnant for the past two months. There is no discoverable cause of a primary focus of infection.

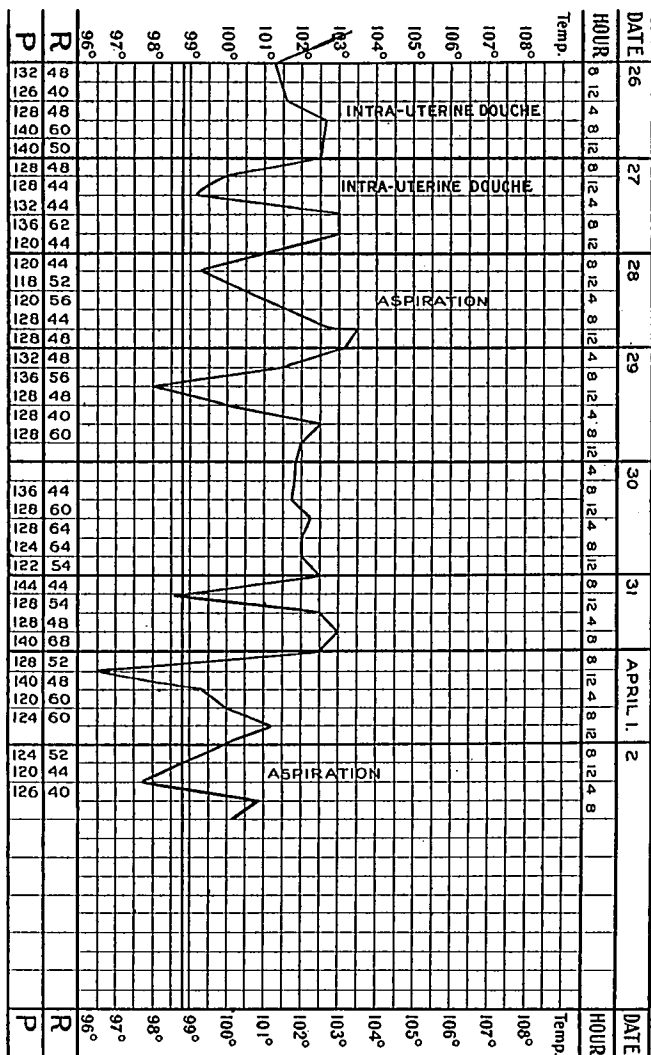
About six weeks before admission to the hospital, patient suffered from malaise. One week later pain in the left chest with cough appeared, the pain being intensified by a deep respiration as well as by the effort of coughing. At the end of another week dyspnoea developed, the symptoms already mentioned having increased in intensity. The bowels were loose, the patient having between fifteen and twenty loose watery movements each day. These, together with the other symptoms, caused general prostration. On admission to the medical ward of the hospital a physical examination showed a diffuse apex beat where the sounds of the heart were very indistinct. The area of cardiac dullness was enlarged to the right. There was a to-and-fro friction sound at the base. There was dullness with diminished voice and breathing from the angle of the scapula downward.

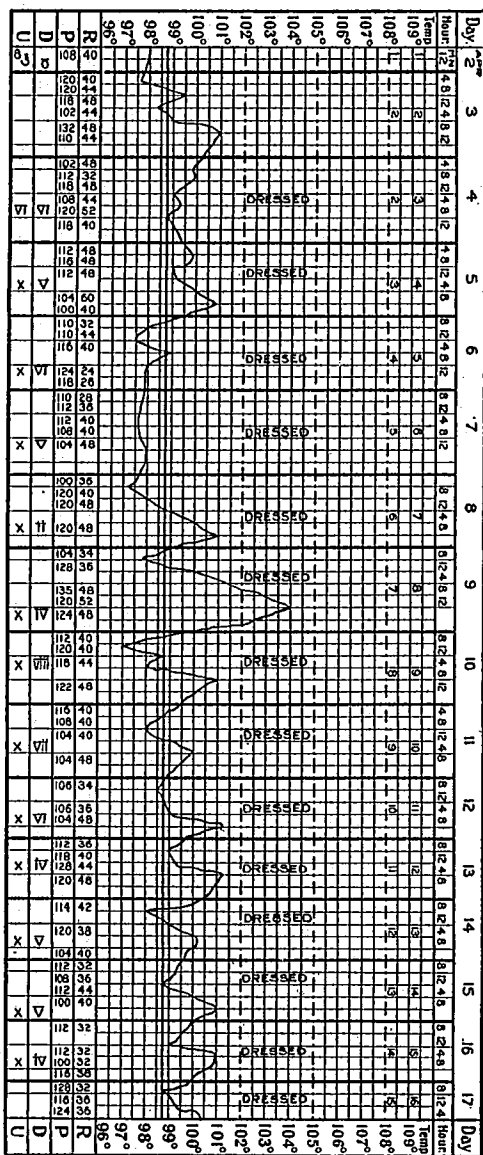
The patient ran an irregularly low temperature for several days. The left pleural cavity was punctured and three ounces of serous fluid withdrawn. About a week after admission, premature labor occurred, with a normal breech presentation. Since then there has been an increase in the dyspnoea with intermittent fever. On the day before the patient was transferred to the surgical ward, puncture of the pericardium by Dr. H. H. Mason gave pus, containing streptococci. At this time, the chief complaints were the dyspnoea, the precordial distress and the intermittent temperature. Physical examination of the chest showed the left border of the precordial dullness to be eight and one-half inches to the left of the midsternal line, while the right border extended two inches to the right of the same line. The action of the heart was regular, and varied between 110 and 120. The respiration was short, labored, between 40 and 50.

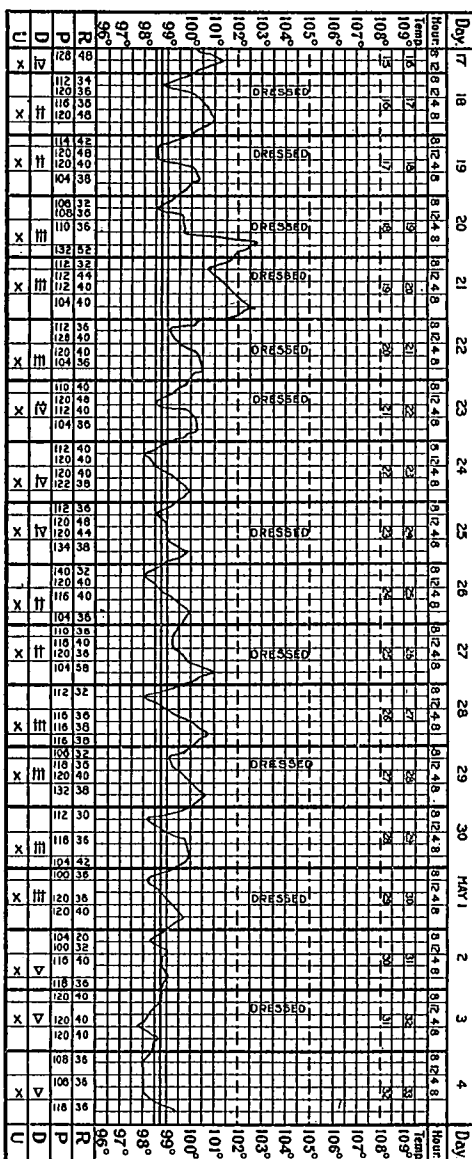
Two aspirations of the pericardium were made, the first of which, in the fifth space one and three-quarters inches to the left of the sternum, was unsuccessful, although a little serum and a few flakes of fibrin escaped from the puncture orifice as the



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needle was withdrawn. The second aspiration in the left same space two inches to the left of the midline withdrew three ounces of thick yellow pus. Leucocytosis: March 15, 23,000; March 20, 31,200; March 24 (day after delivery), 24,600; March 26, 34,200; March 29, 18,800; April 1, 23,200.

Operation.—Gas and ether. Dorsal position. Horizontal incision with resection of the fifth costal cartilage one inch to the left of the sternum. The tissue of the anterior mediastinum was infiltrated, and at least one inch in thickness and spongy. Along a needle previously inserted into the pericardium that cavity was opened with a bistoury and about one pint of pus allowed to escape slowly. The opening was then still further dilated with the finger, which could feel the heart beating distinctly. The pulse became quite rapid during the operation and for a short time after the pericardium was opened was irregular. There was considerable respiratory embarrassment. A rubber drainage tube was inserted and the angles of the incision sutured.

The patient responded well to stimulation with strychnine and whiskey, and on the morning after the operation was in fair condition. The wound was dressed daily, both rubber and gauze drains being used. With the patient on a back rest, the dyspnoea was alleviated. In this condition the patient continued for a week, the abscess cavity draining freely and satisfactorily. One week after the operation, the temperature suddenly rose to 104, the pulse to 140, and the respiration to 52. There was marked cyanosis, and the patient complained of dyspnoea and of precordial distress. Physical examination failed to disclose any explanation of these symptoms and on the following day they had subsided, the pulse decreasing to 120, the respiration between 40 and 50 and the temperature to between normal and 101. From this time further progress of convalescence was uneventful, the patient suffering from occasional slight dyspnoea only. The pulse continued to vary between 110 and 120 throughout. On May 3 the patient was allowed in a chair, and on May 20 was allowed to walk. On May 11 the rubber drain previously shortened was removed and replaced by a small gauze drain, which in turn was discontinued after May 25. Two weeks later the sinus had entirely closed.

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